



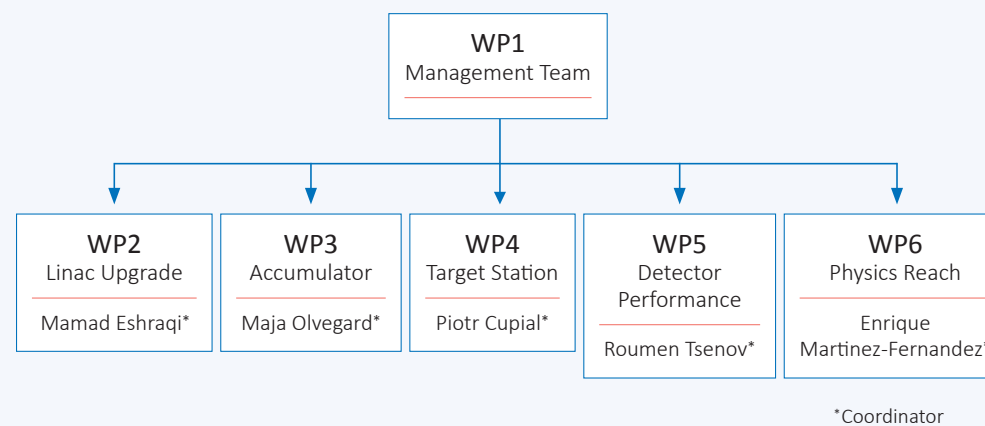
## Partner Countries

Bulgaria	Greece	Spain	Turkey
Croatia	Italy	Sweden	UK
France	Poland	Switzerland	

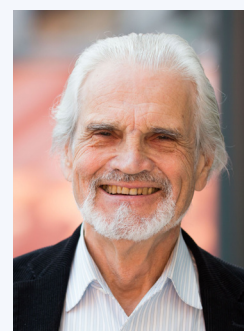
## Partners

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 Akademia Gorniczo-Hutnicza Krakow  
 European Organization for Nuclear Research CERN  
 University of Geneva  
 University of Durham

## Project team and organisation



## Key members



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The world's most intense  
 Neutrino beam project

An Eleven Nation Partnership  
 dedicated to understanding  
 – The moments after the Big Bang –  
 – Why do we exist at all? –

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Credit: European Southern Observatory



# What are neutrinos?

- The lightest fundamental particle
- Elusive and difficult to detect
- Plentiful – they are everywhere
- Travel as fast as light (almost!)
- Three different flavours
- The flavours oscillate!

Big Bang  
The Sun  
The Earth  
Supernovae

## Neutrino Discoveries and Nobel Prizes

- Pauli 1930/1945 [prediction of the neutrino]
- Cowan & Reines 1956/1995 [discovery of the neutrino]
- Davis and Koshiba 1987/2002 [solar & cosmic neutrinos]
- Kajita & McDonald 1998/2001/2015 [neutrino oscillations]

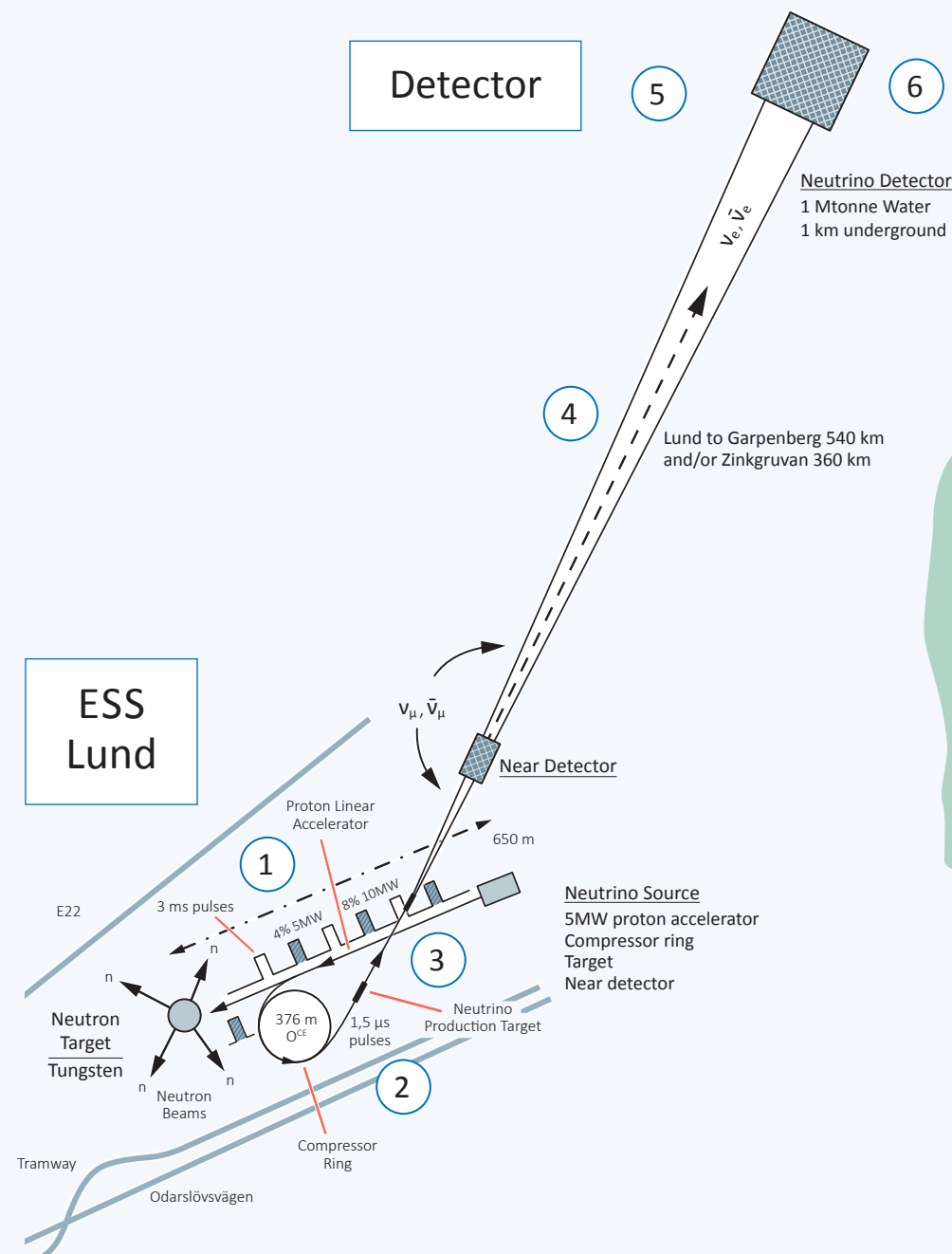
## What is Matter and Antimatter?

- There were equal quantities after the Big Bang
- But there is 'no' antimatter now. Why?
- Symmetry was broken. How?
- Otherwise we would not exist

So why was symmetry broken?

ESSvSB will provide the answer!

# ESSvSB – The Basics



- 1 Proton beam in Lund 5+5 MW
- 2 Protons  $\Rightarrow$  Pions
- 3 Pions  $\Rightarrow$  Neutrinos
- 4 Neutrinos  $\Rightarrow$  Garpenberg 540 km and/or Zinkgruvan 360 km
- 5 Neutrinos detected in million tonne detector
- 6 Data distributed to the rest of the world

# Timeline and Costs



## Advantages of ESSvSB

- Highest production intensity [5MW driver]
- Largest detector [1 million tonnes]
- Greatest sensitivity [2<sup>nd</sup> oscillation maximum]